

ABSTRACT

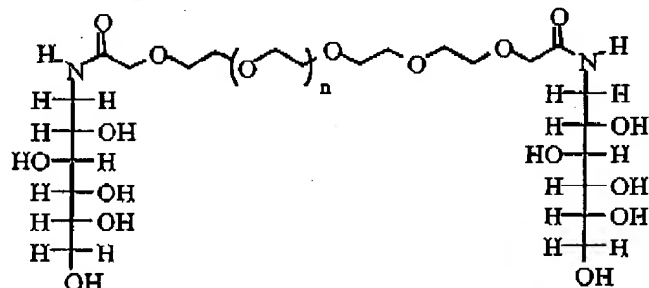
A method of stabilizing a clayey geological formation surrounding a hydrocarbon well is described. It comprises the step of treating the formation with a first reactant and a second reactant, characterized in that a reaction of said first and said second reactant is essentially initiated in the presence of clayey material. The reaction can be characterized by substrate intercalation or condensation stabilization with no pH adjustment or stabilization through reaction of glycol with a carbonyl group containing second reactant or a reaction involving an epoxide ring opening under neutral or acidic conditions.

Table 0. List of abbreviations.

	.A	Acrolein
5	AA	Adipic acid
	BA	Boric acid
10	BNH ₂	$\text{CH}_3\text{CH}(\text{NH}_2)\text{CH}_2-[\text{OCH}(\text{CH}_3)\text{CH}_2]_1-[\text{OCH}_2\text{CH}_2]_m-$ $[\text{OCH}_2\text{CH}(\text{CH}_3)]_n-\text{NH}_2$
	B2P	2- ^t Butylphenol
	B4P	4- ^t Butylphenol
15	DAP	1,5-Diaminopentane
	DEA	Diethanolamine
20	DEC	Diethylcarbonate
	DEM	Dimethylmalonate
	DEO	Diethyloxalate
25	DIT	Diisopropyl-D-tartrate
	DMM	Dimethylmaleate
30	EA	Ethanolamine
	EDA	Ethylene-1,2-diamine or 1,2-diaminoethane
	EG	Ethylene glycol
35	EPP	1,2-Epoxy-3-phenoxypropane
	FS	37 % w/v Formaldehyde solution
40	GA	50% w/v Glutaric aldehyde solution
	HQ	Hydroquinone
	MA	Methyl acrylate
45	OA	Oxalic acid
	P	Phenol
50	PA	2-Acetylpyridine
	PC	2-Pyridinecarboxaldehyde

PO Propylene oxide

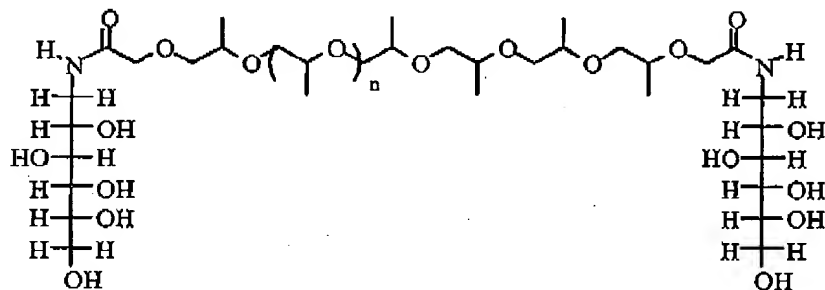
PEDG Polyethylenediglucamide



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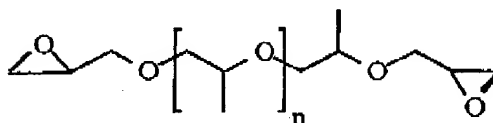
PPD 1,2 Propanediol

PPDG Polypropylenediglucamide



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PPDGE



PEG

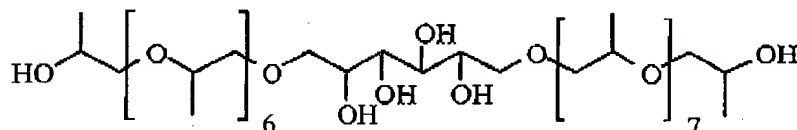


Table 1 (Properties of clay nanocomposite materials synthesized)

Film	Intercalator	Cross-linker	pH	d-spacing (Å)	Film Stability		Film Condition		
					Exfoliates	Stable	Brittle	Flexible	Hard or Soft
1	BNH ₂	FS	na	14.0		Yes		Yes	Hard
2	BNH ₂	MA/H ₂ O ₂	na	-	Yes		Yes		Hard
3	BNH ₂ /PEG	-	na	-		Yes	Yes		Hard
4	PEG	MA	na	-					Hard
5	PEG	MA/H ₂ O ₂	na	-	Yes				Soft
6	PEG	BA	na	-	Yes				Soft
7	EDA	FS	na	14.4		Yes			Hard
8	FS	Catalytic H ₂ O ₂	na	-	Yes	Yes	Yes		Hard
9	EDA	PPDGE	6	-		Yes	Yes	Some	
10	EDA	EPP	6	15.6		Yes		Yes	Hard
11	EDA	PO	6	-		Yes		Yes	
12*	EDA	A	na	-					
13	BNH ₂	PPDGE	6	-	Yes	Yes	Yes		Hard
14	BNH ₂	EPP	6.4	-		Yes		Yes	Hard
15	BNH ₂	PO	6.6	-		Yes	Yes	Some	Hard
16B	4PEG:1BNH ₂	EPP	4	17.3		Yes		Yes	Hard
17	4PEG:1EDA	EPP	5	17.7		Yes	Slightly	Yes	Hard
18	PEG	EPP	na	-	Yes				Soft
19	PEG	PO	na	-	Yes				Soft
20	-	Styrene/H ₂ O ₂	na	-	Yes				Soft
21	PEG	EPP/H ₂ O ₂	na	-	Yes				Soft
22	PEG	PO/H ₂ O ₂	na	-	Yes				Soft
23	DAP	FS	na	-		Yes	Yes		Hard
24	DAP	-	na	-		Yes		Yes	Hard
25	DAP	EPP	6.5	18.6		Yes	Slightly		Hard
26	DAP	PO	6.5	-		Yes	Yes		
27	DAP	PO/EPP	na	17.2		Yes	Yes		Hard
28	EDA	PPDGE	2	14.1		Yes		Yes	Hard
29	BNH ₂	PPDGE	2	15.9		Yes	Yes		Hard
30	PEG	PPDGE	2	17.5		Yes		Yes	Soft
31	PEG	PO	2	16.5	Yes	Yes			Soft

Table 1 (continued)

Film	Intercalator	Cross-linker	pH	d-spacing (Å)	Film Stability		Film Condition		
					Exfoliates	Stable	Brittle	Flexible	Hard or Soft
32	PEG	EPP	2	16.8	Yes	Yes			Soft
33	EDA	A	na	15.1		Yes		Yes	Hard
34	EDA	PC	na	17.7		Yes		Yes	Hard
35	EDA	PA	na	15.1		Yes			Hard
36*	EDA	AA	6	12.7		Yes		Yes	Hard
37	EDA	AA	na	15.0		Yes		Very	Hard
38*	EDA	AA	2	13.0		Yes		Yes	Hard
39*	EDA	OA	6	15.5		Yes	Yes	Slightly	Hard
40	EDA	OA	na	15.1		Yes		Very	Hard
41*	EDA	OA	2	15.6		Yes		Yes	Hard
42	EDA	GA	na	15.5		Yes		Yes	Hard
43	BNH ₂	GA	na	-∞	Yes	Yes		Yes	
44	PEDG	PO	6	-	Yes				
45	PEDG	EPP	6	-	Yes				
46	PEDG	PDGB	6	-	Yes				
47	PPDG	PO	6	-	Yes				
48	PPDG	EPP	6	-	Yes				
49	PPDG	PDGE	6	-	Yes				
50	EDA	DEC	na	-		Yes		Very	Hard
51	BNH ₂	DEC	na	-		Yes	Yes		Hard
52	DAP	DEC	na	-		Yes		Very	Hard
53	EA	DEC	na	-		Yes		Yes	Hard
54	DEA	DEC	na	-		∪			Soft
55	EG	DEM	na	-	Yes	∪			Soft
56	EG	DMM	na	-	Yes	∪			Soft
57	EG	DIT	na	-	Yes	Yes		Yes	
58	EG	DEO	na	-	Yes	Yes		Yes	
59	PPD	DEM	na	-	Yes				Soft
60	PPD	DMM	na	-	Yes	∪			Soft
61	PPD	DIT	na	-		Yes		Yes	
62	PPD	DEO	na	-	Yes	∪			Soft
63	HQ	FS	na	-		Yes		Yes	Hard
64	P	FS	na	-	Some	Yes		Yes	Hard
65	B4P	FS	na	-		Yes		Yes	Hard
66	B2P	FS	na	-	Yes	Yes	Slightly	Yes	Hard

+ film 12 resulted in polymerisation of the intercalator solution on addition of the acrolein
* considerable precipitation of intercalator/cross-linker complex
to although film 43 is stable no d-spacing was measured due to the non-homogeneous nature of the treated film
1. All these films decompose upon overnight soaking in fresh water